WHAT IS CLAIMED IS:

1. A method for determining the presence or concentration of a substance in a medium, the method comprising:

a) providing a sensor in the medium, wherein the sensor includes at least one optical carrier and a microsphere having a surface including receptors for the substance, wherein the receptors are provided substantially at a belt surface area including an equator of the microsphere, and wherein surface areas of the microsphere other than the belt surface area are substantially free of receptors, each of the at least one optical carrier being coupled with the microsphere;

b) applying a light source to one of the at least one optical carriers of the sensor;

c) detecting light from one of the at least one optical carriers of the sensor; and

d) determining a presence or concentration of the substance based on a property of the detected light, wherein the property is based on a shift in resonance of the microsphere.

2. The method of claim 1 wherein the light source emits light at a wavelength λ, wherein the microsphere has a radius R and a refractive index n, and wherein an arclength width of the belt is substantially the square root of $R\lambda/2\pi n$.

3. The method of claim 1 wherein the microsphere is formed of a material having an index of refraction in water of approximately 1.7.

4. The method of claim 1 wherein the microsphere has a radius in a range of 3.6-10 μm.

5. The method of claim 1 wherein each of the at least one optical carriers of the sensor are optically coupled with the microsphere at the equator.

6. The method of claim 1 wherein the microsphere is formed of amorphous sapphire.

7. The method of claim 1 wherein light source is controlled to emit light in the blue spectrum.

8. The method of claim 7 wherein light source is controlled to emit light at about 400 nm.

9. The method of claim 1 wherein the shift in resonance of the microsphere is detectable when any of the receptors in the belt surface area capture a single molecule having a mass of about 200,000 Da.

10. A system for determining the presence or concentration of a substance in a medium, the system comprising:

a) a sensor, for immersion in the medium, the sensor including

i) at least one optical carrier, and

ii) a microsphere having a surface including receptors for the substance, wherein the receptors are provided substantially at a belt surface area including an equator of the microsphere, and wherein surface areas of the microsphere other than the belt surface area are substantially free of receptors, each of the at least one optical carrier being coupled with the microsphere;

b) a light source for applying light to one of the at least one optical carriers of the sensor;

c) a detector for detecting light from one of the at least one optical carriers of the sensor; and

d) means for determining a presence or concentration of the substance based on a property of the detected light, wherein the property is based on a shift in resonance of the microsphere.

11. The system of claim 10 wherein the light source emits light at a wavelength λ, wherein the microsphere has a radius R and a refractive index n, and wherein an arclength width of the belt is substantially the square root of $R\lambda/2\pi n$.

12. The system of claim 10 wherein the microsphere is formed of a material having an index of refraction in water of approximately 1.7.

13. The system of claim 10 wherein the microsphere has a radius in a range of 3.6-10 μm.

14. The system of claim 10 wherein each of the at least one optical carriers of the sensor are optically coupled with the microsphere at the equator.

15. The system of claim 10 wherein the microsphere is formed of amorphous sapphire.

16. The system of claim 10 wherein light source is controlled to emit light in the blue spectrum.

17. The system of claim 16 wherein light source is controlled to emit light at about 400 nm.

18. The system of claim 10 wherein the shift in resonance of the microsphere is detectable by the detector when any of the receptors in the belt surface area capture a single molecule having a mass of about 200,000 Da.

19. For use in a system including a light source, and a light detector, for determining the presence or concentration of a substance in a medium, a sensor comprising:

a) at least one optical fiber;

b) at least one microsphere, the at least one microsphere

i) being coupled with the optical fiber,

ii) having a surface including receptors for the substance, wherein the receptors are provided substantially at a belt surface area including an equator of the microsphere, and wherein surface areas of the microsphere other than the belt surface area are substantially free of receptors, each of the at least one optical carrier being coupled with the microsphere,

wherein, when light is applied to the optical fiber, a resonance within the microsphere is excited,

wherein, if the substance adsorbs to the receptors on the microsphere surface, a shift in the resonance occurs, and

wherein a presence or concentration of the substance can be determined based on the shift in resonance.

20. The sensor of claim 19 wherein the substance is a protein, and

wherein the receptors are complementary amines.

20. The sensor of claim 19 wherein the substance is a virus particle, and wherein the receptors are complementary to the virus particle.

21. The sensor of claim 19 wherein the substance is DNA, and
wherein the receptors are complementary to the DNA.

22. The sensor of claim 19 wherein the microsphere is formed of a material having an index of refraction in water of approximately 1.7.

23. The sensor of claim 19 wherein the microsphere has a radius in a range of 3.6-10 μm.

24. The sensor of claim 19 wherein each of the at least one optical fibers of the sensor are optically coupled with the microsphere at the equator.

25. The sensor of claim 19 wherein the microsphere is formed of amorphous sapphire.

26. A method for fabricating a sensor for determining the presence or concentration of a substance in a medium, the method comprising:
a) optically coupling at least one microsphere and an at least one optical core; and
b) providing a surface of the microsphere with a receptor complementary to the substance, wherein the receptors are provided substantially at a belt surface area including an equator of the microsphere, and wherein surface areas of the microsphere other than the belt surface area are substantially free of receptors.

27. The method of claim 26 wherein the act of providing a surface of the microsphere with a receptor complementary to the substance, wherein the receptors are provided substantially at a belt including an equator of the microsphere, and wherein surface areas of the microsphere other than the belt surface area are substantially free of receptors includes
i) applying a binding agent to the surface of the microsphere;
ii) selectively establishing the receptors on the belt surface area by attaching receptors to the binding agent substantially at only the belt surface area.

28. The method of claim 27 wherein the act of providing a surface of the microsphere with a receptor complementary to the substance, wherein the receptors are provided substantially at a belt including an equator of the microsphere, and wherein surface areas of the microsphere other than the belt surface area are substantially free of receptors further includes

iii) making the surface areas of the microsphere other than the belt surface area non-reactive.

29. The method of claim 27 wherein the act of applying a binding agent to the surface of the microsphere includes coating the microsphere with 2-(3-4 epoxycyclohexyl) ethyltrimethoxysilane.

30. The method of claim 27 wherein the act of selectively establishing the receptors on the belt surface area by attaching receptors to the binding agent substantially at only the belt surface area includes

A) placing the microsphere in a solution of amines or a vapor including amines, and

B) irradiating the belt surface area with UV light.

31. The method of claim 30 wherein the amines are ammonia ethylenediamine.

32. The method of claim 30 wherein the optical core is optically coupled with the equator of the microsphere, and

wherein the act of irradiating the belt surface area with UV light is performed by providing UV light to the optical core.

33. The method of claim 28 wherein the act of making the surface areas of the microsphere other than the belt surface area non-reactive includes

A) placing the microsphere in a solution of mono-secondary amines or a vapor including mono-secondary amines, and

B) irradiating the microsphere with UV light.

34. The method of claim 28 wherein the act of making the surface areas of the microsphere other than the belt surface area non-reactive includes

A) placing the microsphere in a solution of mono-secondary amines or a vapor including mono-secondary amines, and

B) heating the microsphere.

35. The method of claim 26 wherein the act of optically coupling at least one microsphere and an at least one optical core is performed such that the at least one optical core is optically coupled with the equator of the at least one microsphere.